

## RELATIONSHIP BETWEEN MILK YIELD, MILKING PARAMETERS AND UDDER EVALUATION OF CZECH WHITE GOATS

*Birutė Šlyžienė, Vida Juozaitienė, Evaldas Šlyžius*

*Department of Animal Breeding and Nutrition, Veterinary Academy, Lithuanian University of Health Sciences  
Tilžės g. 18, LT-47181, Kaunas, Lithuania, phone +37068922573; e-mail: evaldas.slyzius@lsmuni.lt*

**Abstract.** The aim of this study was to estimate milk yield, milk flow traits and their relationship with the udder score. Milking traits of 97 Czech White goats, which were milked into a milk line, were studied using the Lactocorder® device (Lactocorder® WMB AG, Switzerland). Following evaluation of parameters of goat milk yield in different lactations the highest total milk yield were established in the II lactation goats. The longest duration of the total milking were established in the III and later lactation goats, while the time highest milk flow were established in the II lactation goats. Having analysed the duration of the milking phase, it has been established that duration of the main milking phase, duration of the plateau phase and duration of the descending phase in the III and later lactation goats were correspondingly 0.19, 0.25 and 0.26 minute longer than the average indicator ( $p < 0.05$ ). The highest milk flow rate and the highest average milk flow were in the I lactation goats. Having performed the analysis of the assessments of the goat udder milking traits according to the udder score and the evaluation of the dairy breeding goats, it was established that the goats with higher assessment scores have better milking parameters. Previously, selection of the dairy goats were based on the assessment of the morphological traits due to lack of registration of the productivity data. Today, in addition to the productivity data, the goat farmers in many countries use milking parameters in selection as well. These are important parameters, which must be registered and evaluated, because they provide information, which can facilitate management of goat farming.

**Keywords:** goat, udder, milk, milking parameters

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### Introduction

Goat milk is a valuable food product that had been consumed for thousands of years (Gaddour et al., 2009; Tabbaa and Al-Atiyat, 2009). Goat milk is used to produce butter, kefir, curd, yoghurt, cheese and other products. The range and quality of products depend on the quality of goat milk. A number of factors are responsible for the quality of milk: udder health and milking quality, animal genetics, nutrition (Peris et al., 1999; Ilahi et al., 2000; Okpeku et al., 2011; Borghese et al., 2013). Since the goats are very well eating grass forage, so these animals worth growing in Lithuania. Climatic conditions are very favourable for the growing of herbal feed in the Baltic countries, as well it is one of the cheaper feed, so it is necessary more use it in the feed ration.

According to the data of FAOSTAT (the Statistics Division of the Food and Agriculture Organization of the United Nations), annual global production of goat milk comprises 1,792 million tons. The largest number of goats and the highest milk production are registered on the Asian and African continents (FAOSTAT, 2015). Europe's share in the globally produced goat milk quantity makes 11 per cent. In Europe, goat milk production is especially important economically and attracts many investments. It is Europe that had developed the most productive goat breeds: Alpine, Saanen, Toggenburg, Czech White and others. The goats of these breeds were widely exported to other countries for improvement of milk qualities of the local breeds (Dubeuf et al., 2005; Haenlein, et al. 2004; Ines et al., 2010). In the past several years, the popularity of goat farming in Lithuania is growing. According to the data provided by the State Enterprise Agricultural Information and Rural Business Centre, the following breeds are reared in Lithuania: Lithuanian local goats, Saanen, Czech White, Latvian local goats, Alpine and other breeds. At the moment 14,275 goats are bred in Lithuania, of which 5,333 are nanny goats.

The main aim of the goat milk farming is to improve the parameters, which are responsible for milk productivity (Ciappesoni et al., 2004; Bueso-Ródenas et al., 2014). Milk yield and milking parameters depend on the udder anatomy (Ferreira et al., 2013), environmental conditions and health status (Boselli et al., 2009; Borghese et al., 2013). Goat milk yield and milk flow are important parameters, which must be evaluated and registered (Borghese et al., 2013).

The scientific studies (Salama et al., 2003; Ciappesoni et al., 2004; Keskin et al., 2005; Bašič et al., 2009) have demonstrated that milk yield, milking duration and milking flow rate parameters are related to lactation and udder measurements. The study with the Czech White goats carried out by Ciappesoni et al. (2004) demonstrated that milk yield increased with the increase of lactation. On the contrary results of the study with Murciano-Granadina breed of goats carried out by Salama et al. (2003) demonstrated decreasing of milk yield with the increase of lactation number. Bašič et al. (2009) study carried out with the Alpine goats determined that the highest average and maximum milk flow rate increased with the increase of lactation. **The aim of this study** was to estimate milk yield, milk flow traits and their relationship with the udder score.

### Materials and methods

Milking traits of 97 Czech White goats, which were milked into a milk line, were studied using the Lactocorder® device (Lactocorder® WMB AG, Switzerland). All used animals raised at the same feeding and housing conditions in

the experiment. During the investigation period, goats received feed produced in the farm: pasture grass, hay and oat meal.

Goat udder was evaluated according to the Goat Evaluation Rules approved by Order No. 1A-23 of 15 December 2006 of the Head of the State Animal Breeding Supervision Service under the Ministry of Agriculture.

Adult goats and I lactation goats with a large, well-formed, round or pear-shaped udder and long teats were evaluated at 5 points.

Adult goats and I lactation goats with an average-sized, round or pear-shaped udder and long teats were evaluated at 4 points.

Adult goats with a smaller, irregularly shaped, pendulous udder with asymmetrical sides and small teats were evaluated at 2.5 points.

I lactation goats with a smaller, irregularly shaped, pendulous udder with asymmetrical sides and small teats were evaluated at 2.5 points.

Milking parameters were evaluated using LactoPro 5.2.0 program:

Milk yield parameters:

MGG – Total milk yield, kg;

HMG – Maximal milk flow rate in one minute, kg;

1MG – Amount of milk within the first minute, kg;

2MG – Amount of milk within the first two minutes, kg;

3MG – Amount of milk within the first three minutes, kg;

MNG – Strip yield, kg.;

Milking duration parameters:

tMGG – Duration of the total milking, min;

tHMF – Time of the highest milk flow, min;

tS500 – Time to reach 250 g. at beginning, min;

tMHG – Duration of the main milking phase, min;

tPL – Duration of the plateau phase, min;

tAB – Duration of the descending phase, min;

tMBG – Duration of the dry milking phase, min;

tMNG – Duration of the stripping phase, min;

tMBG2 – Duration of dry milking after stripping, min;

t400 – Time to get from 0.2 to 0.1 kg/min;

tAnD – Time diff. for recognizing plateau in ascending, min;

tAbD – Time diff. for recognizing plateau in descending, min;

tAn – Duration of the ascending phase, min.;

Milking flow rate parameters:

HMF – Maximal milk flow rate in one minute, kg/min;

DMHG – Average milk flow in the main milking phase, kg/min.

The research was conducted following the provisions of the Law of the Republic of Lithuania No. 11-2271 on Protection, Keeping and Use of Animals, dated 03/10/2012 (Valstybės žinios (official gazette) No. 122- 6126 dated 20/10/2012) and of the by-laws, and Education and training purposes of animals used in storage, maintenance and conditions of use No. B1-866, dated 31/10/2012 (Valstybės žinios (official gazette) No. 130-6595 dated 10/11/2012).

After conduction of the study, the goats were grouped according to lactation (first (n=23), second (n=40), third and later lactations (n=34)). All 97 goats were evaluated 4 (22 %) and 5 (78 %) points. Statistical data analysis were calculated using the “R” (The R Project for Statistical Computing, 2015) statistics packages. The results are considered to be reliable when  $P \geq 0.05$ .

### Results

Following evaluation of parameters of goat milk yield in different lactations (Table 1) the highest total milk yield was established in the II lactation goats. This indicator was by 0.14 kg higher as compared to the III and later lactation goats group, and by 0.34 kg higher as compared to the I lactation goats group ( $p < 0.05$ ). Higher amount of milk within the first two and first three minutes was also established in the II lactation goats. This indicator was higher than the average by 0.07 kg and 0.12 kg respectively.

As the data provided in Table 2 suggests, the longest duration of the total milking was established in the III and later lactation goats, while the time highest milk flow was established in the II lactation goats. It has been determined that the duration of the total milking in the III and later lactation goats was 0.1 minute longer than in the II lactation goats and 0.57 minute longer than in the I lactation goats ( $p < 0.05$ ). Having analysed the duration of the milking phase, it has been established that duration of the main milking phase, duration of the plateau phase and duration of the descending phase in the III and later lactation goats were correspondingly 0.19, 0.25 and 0.26 minute longer than the average indicator ( $p < 0.05$ ). It has been determined that in the I lactation goats duration of the dry milking phase was 0.05 minute longer

than in the III and later lactation goats, and 0.04 minute longer than in the II lactation goats. Evaluation of the milk flow parameters according to lactation (Table 2), has shown that the highest milk flow rate and the highest average milk flow were in the I lactation goats. These parameters were slightly higher than the herd's average by 0.05 kg/min and 0.03 kg/min respectively.

Table 1 Milk yields parameters evaluation for different lactation of goats

Parameters	I lactation <sup>a</sup>	II lactation <sup>b</sup>	III and later lactation <sup>c</sup>
MGG	1.41±0.12 <sup>*b</sup>	1.75±0.10 <sup>*a</sup>	1.61±0.08
HMG	0.78±0.06	0.79±0.03	0.74±0.03
1MG	0.70±0.05	0.72±0.03	0.66±0.03
2MG	1.12±0.08	1.24±0.06	1.22±0.05
3MG	1.29±0.10	1.51±0.08	1.44±0.06
MNG	0.05±0.02	0.02±0.01	0.02±0.01

<sup>abc</sup> Means with different superscript letters indicate significant differences between lactation; \*P<0.05

Table 2 Milking duration and flow rate evaluation for different lactation of goats

Parameters	I lactation <sup>a</sup>	II lactation <sup>b</sup>	III and later lactation <sup>c</sup>
tMGG	2.91±0.17 <sup>*c</sup>	3.38±0.19	3.48±0.27 <sup>*a</sup>
tHMF	0.78±0.11 <sup>**b</sup>	1.21±0.12 <sup>**a</sup>	1.06±0.11
tS500	0.09±0.02	0.11±0.01	0.08±0.01
tMHG	2.22±0.19 <sup>*b; *c</sup>	2.80±0.18 <sup>*a</sup>	2.92±0.22 <sup>*a</sup>
tPL	0.91±0.15 <sup>***b; **c</sup>	1.40±0.16 <sup>***a</sup>	1.63±0.12 <sup>**a</sup>
tAB	0.99±0.17	0.92±0.09 <sup>*c</sup>	1.37±0.19 <sup>*b</sup>
tMBG	0.41±0.07	0.37±0.08	0.38±0.07
tMNG	0.16±0.07	0.08±0.03	0.05±0.02
tMBG2	0.04±0.02	0.03±0.01	0.04±0.02
t400	0.09±0.02	0.06±0.01	0.07±0.01
tAnD	0.09±0.03	0.13±0.03	0.14±0.03
tAbD	0.46±0.14	0.25±0.05	0.60±0.18
tAn	0.31±0.06 <sup>*c</sup>	0.24±0.04	0.16±0.04 <sup>*a</sup>
HMF	0.89±0.05	0.86±0.04	0.82±0.04
DMHG	0.64±0.05	0.64±0.03 <sup>*c</sup>	0.56±0.02 <sup>*b</sup>

<sup>abc</sup> Means with different superscript letters indicate significant differences between lactation; \*P<0.05; \*\*P<0.01; \*\*\*P<0.001

Having analysed the milk yield parameters according to the udder score (Table 3), it has been established that the milk yield in goats with udder score of 5 points was by 0.36 kg higher than in goats with udder score of 4 points. Higher milk yield within the first two and first three minutes was also established in the goats with the udder score of 5 points. This parameter was from 0.06 to 0.2 kg higher.

Table 3 Milk yields parameters evaluation by udder score

Parameters	Udder score	
	4	5
MGG	1.43±0.18	1.79±0.12
HMG	0.79±0.09	0.85±0.04
1MG	0.75±0.08	0.75±0.03
2MG	1.27±0.15	1.33±0.07
3MG	1.37±0.16	1.58±0.10
MNG	0.04±0.02	0.02±0.01

As demonstrated by the data in Table 4, duration of milking was by 0.68 minutes and the time of the highest milk flow rate was by 0.3 minute longer in the goats with the udder score of 5 points ( $p<0,05$ ). In the goats with the udder score of 5 points, the established duration of the main milking phase was 0.7 minute ( $p<0,05$ ), duration of the plateau phase was 0.45 minute longer, duration of the descending phase was 0.13 minute longer, and duration of the stripping phase was 0.1 minute longer, while duration of the dry milking phase was 0.06 minute shorter. The analysis of the milk

flow parameters (Table 4) according to the udder score demonstrated that the maximum milk flow rate was 0.04 kg/min higher and the average milk flow was 0.02 kg/min higher in the goats with the udder score of 5 points.

Table 4 **Milking duration and flow rate evaluation by udder score**

Parameters	Udder score	
	4 <sup>a</sup>	5 <sup>b</sup>
tMGG	2.72±0.26 <sup>*b</sup>	3.40±0.28 <sup>*a</sup>
tHMF	0.76±0.13	1.06±0.12
tS500	0.09±0.02	0.09±0.01
tMHG	2.12±0.21 <sup>*b</sup>	2.82±0.28 <sup>*a</sup>
tPL	0.99±0.21	1.44±0.17
tAB	1.01±0.24	1.14±0.21
tMBG	0.46±0.11	0.40±0.11
tMNG	0.06±0.03	0.07±0.03
tMBG2	0.01±0.01	0.02±0.01
t400	0.05±0.01	0.06±0.02
tAnD	0.09±0.04	0.15±0.04
tAbD	0.25±0.15	0.37±0.20
tAn	0.12±0.06	0.23±0.05
HMF	0.89±0.09	0.93±0.04
DMHG	0.64±0.06	0.66±0.03

<sup>ab</sup> Means with different superscript letters indicate significant differences between udder score; \*P<0.05; \*\*P<0.01; \*\*\*P<0.001

Having analysed correlation between the lactation, milk yield and milking traits, a positive statistically reliable correlation coefficient was established between the milk yield and the highest milk flow rate ( $r=0.360$ ;  $p<0.01$ ) and between the lactation and the duration of milking ( $r=0.266$ ;  $p<0.05$ ). Even more statistically significant correlation coefficient was established between the milk yield and the duration of milking ( $r=0.550$ ;  $p<0.001$ ). Furthermore, a statistically reliable negative correlation coefficient was established between the highest milk flow rate and the lactation ( $r=-0.267$ ;  $p<0.05$ ).

#### Discussion

The main parameters playing an important role, and which are related to automatic milking, are the udder evaluation, milking duration, milk flow and their correlation with milk yield (Peris et al., 1999).

The performed study has demonstrated the highest milk yield in the II lactation goats as compared to milk yield in the I, III and later lactation goats. The study with the Czech White goats carried out by Ciappesoni et al. (2004) demonstrated that milk yield increased with the increase of lactation from the first to the third lactation: from 11.7 per cent when comparing the I and II lactations to 15 per cent when comparing the II and III lactations.

The results of the study involving Murciano-Granadina breed of goats carried out by Salama et al. (2003) demonstrated reduction of milk yield with the increase of lactation number. The study results presented by Palhiere et al. (2014) revealed that the milk yield within the first minute, and the average and maximum milk flow rate was higher in the Alpine goats as compared to the Saanen breed of goats.

Our study results have demonstrated the highest milk flow rate and the highest average flow rate in the I lactation goats. The study performed by Peris et al. (1999) revealed that the maximum milk flow rate was higher in the second lactation goats than in the first and third and later lactation goats. Bašić et al. (2009) study carried out with the Alpine goats determined that the highest average and maximum milk flow rate was in the fourth lactation goats as compared to the third lactation goats. The third lactation goats had a higher milk yield and a longer milking duration.

Udder is one of the most important external parameters of the breeding goats. It is important to maintain udder health and its suitability for automatic milking. The significance of udder assessment is also confirmed in the study carried out by Keskin et al. (2005), which established the correlation between the udder measurements (depth, width) and milk yield ( $r=0.473$  and  $r=0.721$ ). Peris et al. (1999) established positive correlation coefficients between the milk yield and udder volume, between the teat length and milk flow, and between the milk yield and milking duration. Ilahi et al. (2000) carried out the study involving Alpine goats, which revealed that the genetic and phenotypic correlations between the milking duration and dairy traits were low, positive for yields and negative for contents.

#### Conclusions

Data analysis showed that the highest total milk yield, amount of milk within the first two and first three minutes was established in the second lactation goats. The highest milking flow rate parameters were established in the first lactation goats.

Having performed the analysis of the assessments of the goat udder milking traits according to the udder score and the evaluation of the dairy breeding goats, it was established that the goats with higher assessment scores have better

milking parameters. Today the goat farmers using extra milking and udder evaluation parameters of selection to the productivity data in many countries as well. These are important parameters, which must be registered and evaluated, because they are providing information, which can facilitate management of goat farming.

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